CHEN 4810: Biological Engineering Lab  
Department of Chemical and Biological Engineering  
University of Colorado  
Spring 2017

Course Learning Goals
1. Provide experience with planning, design and implementation of experiments
2. Provide experimental experience with heat transfer and fluid mechanics.
3. Provide experimental experience with biological separations, recombinant protein production and cell growth kinetics in bioreactors.
4. Application of statistical analysis to experimental data.
5. Experience working in a simulated industrial environment on “teams”.
6. Improvement of written communication of experimental results.

Instructor
Melissa Mahoney (Instructor) melissa.mahoney@colorado.edu

Lab Coordinator
Ann Greco ann.greco@colorado.edu

In general, the instructor and lab coordinator will be available in the laboratory area or their offices during the lab section periods (Wednesday afternoons). This is a great time to ask questions about the experiments that you are or will be completing. Your instructor will also be available on Monday afternoons from 12:45 – 2:15 for questions related to the course. Meetings outside of these time frames should be arranged by email or in person.

General Format of the Course
Each group of 3-4 students will complete tutorials or experiments according to the schedule posted on the course website in D2L. The first two experiments will focus on heat transfer and fluid mechanics. The last three experiments will focus on biological separations, cell growth kinetics, and recombinant protein production.

Although the class is expected to meet on Wednesday from 1:00-6:00 pm, you will need to meet at other times with your group outside of the scheduled time slot to analyze data and prepare reports.

During the first week of the experiment the pre-laboratory assignment posted on D2L is due Tuesday by 5pm (see course schedule for all due dates). The pre-lab assignment will require you to do some research to collect background information and physical property data. In addition, you may need to visit the lab ahead of time to become familiar with the experiment and to develop an experimental plan. You will also need to develop a calculation flow chart for theoretical calculations pertaining to the experiment (Hint: Do not wait until Monday to begin your pre-lab assignment). The week after the two week experiment is completed “Key Results” are due. A written report (partial or full) is due three weeks after experiment completion (Experiments 3, 4, and 5 only). Guidelines for each of these assignments can be found on the course website in D2L.

Electronic lab notebooks must be maintained by each group throughout the semester. Periodically your instructor will grade your notebook and provide feedback on how to improve. This will help twice over the course of the semester and you will not be given advanced notice.
**Note:** Each student group will need to provide their own safety glasses available at the CU Bookstore.

**Desire2Learn Site**
The course has a site on D2L. Students enrolled in the course will be able to find pertinent information related to the course, including experiment descriptions, expectations, and a variety of tutorials and information related to, among others, how to put together written reports, how to create scientific figures, the fundamentals of error analysis, and more. There is no official textbook that is required for this course.

**Assignments and Grading Basis**
Please see the Assignment Schedule in D2L for a list of due dates and points per assignment. Many, if not all, assignments will be turned in through D2L. *Turn your assignments in on time or you will be heavily penalized!!!*

*Assignments turned in late will be counted for 50% of possible points for 24 hours after the due date/time. No credit will be given for assignments turned in 24 hours past the due date.*

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<tr>
<th>Pre-laboratory Assignment</th>
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<tbody>
<tr>
<td>Pre-lab Experiment 1</td>
<td>1 exp x 20 pts</td>
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<tr>
<td>Pre-lab Experiments 2 - 5</td>
<td>4 exp x 35 pts</td>
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<tr>
<th>Key Results Assignment</th>
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<tbody>
<tr>
<td>Key Results Experiment 1</td>
<td>1 exp x 30 pts</td>
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<tr>
<td>Key Results Experiments 2 - 5</td>
<td>4 exp x 60 pts</td>
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<th>Group Written Reports</th>
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<tr>
<td>GR Experiment 3</td>
<td>1 exp x 40 pts</td>
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<tr>
<td>GR Experiment 4 - 5</td>
<td>2 exp x 100 pts</td>
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<th>Team Member Evaluation</th>
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<td>Peer assessment at semester end</td>
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<table>
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<th>Student Evaluation by Instructor</th>
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<tbody>
<tr>
<td>Instructor assessment at semester end</td>
<td>130</td>
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<th>Laboratory Notebook Evaluation</th>
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<tr>
<td>Experiments 1 - 5</td>
<td>2 checks x 25 pts</td>
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<th>Tutorials</th>
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<th>Total points in the course</th>
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<td></td>
<td>1000 points</td>
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**Letter Grades**
Letter grades will be assigned according to the curve below. The instructor does reserve the right to lower the score required for a letter grade. +/- grades will be assigned at the upper and lower end of the numerical ranges.

90-100 A
80-90 B
65-80 C
50-65 D
<50 F

**Attendance**
- ALL GROUP MEMBERS MUST ATTEND ALL CLASSES
- Each unexcused absence will result in a 10% deduction of the final grade.
- Even if you do not need to conduct experiments on the 2nd experimental day, you must check in with the instructor at the beginning of class
- If you must miss a class, work with the instructor ahead of time to see if a make-up is possible

**Lab Make-Ups**
- If ALL group members have attended BOTH experimental sessions for a particular experiment and the group still does not have sufficient data, please work with the instructor to see if a make-up outside normal class hours is possible
- If all group members have NOT attended both experimental sessions, please do not ask to make up a lab outside of the normal class period

**Lab Safety**
In conducting the Chemical and Biological Engineering Laboratory courses, we require the following practices of students, teaching assistants, and faculty.

1. **Eye Protection**

You must wear eye protection in the lab area. Eye protection must meet ANSI standards. Minimum protection consists of spectacles with side shield.

Full, ventilated goggles may be purchased at the UMC Book Store or McGuckin’s Hardware for about $4. These do provide good protection but are not particularly comfortable. An acceptable and more comfortable alternative is plain spectacles with side shields, available at McGuckin’s for $15 to $20.

If you wear glasses, you may obtain safety spectacles with side shields to wear over your glasses. You may also obtain prescription safety glasses with side shields. The lenses in prescription safety glasses are thicker than standard glasses.

If you obtain proper eye protection for this course, it will serve your need in future lab and industrial situations.

If you are observed in the lab without eye protection, you risk being disenrolled from the course.

2. **Dress and Appearance (from *Safety in Academic Chemistry Laboratories*, ACS, 1992)**

High-heeled or open-toed shoes, sandals, or shoes made of woven material should not be worn in the lab. Shorts, cut-offs, or short skirts are not permitted. Long hair and loose clothing should be constrained. Jewelry such as rings, bracelets, and watches should not be worn, to prevent chemical seepage under the jewelry, contact with electrical sources, catching on equipment, and damage to the jewelry itself.

3. **Chemical Safety**

Material Safety Data Sheets (MSDS) must be obtained for all experiments using chemicals. Each group member must read and understand the safety precautions and disposal procedures.

Waste chemicals are to be disposed of in appropriate containers located in the Satellite Accumulation Areas (SAA’s). They are never to be poured down drains! Chemicals must be stored in approved and labeled containers. Solid materials contaminated by waste chemicals are disposed of in appropriate containers and must not be placed in the standard wastebaskets.
Waste materials, especially “sharps” such as needles and broken glass, must be placed in special containers for these materials. Do not place these items in the standard wastebaskets.

4. Behavior in the Laboratory

Don’t
- Run
- Yell, except in an emergency
- Eat, drink, or smoke
- Engage in horseplay or mischief
- Ride anything (bikes, skateboards, inline skates)

Do
- Keep an eye out for hazards
- Think before you act
- Ask, if you have any doubt
- Take your time
- Be careful
- Inform and stay informed

5. Safety Devices

Know where all the fire extinguishers in the vicinity of the lab are and know their type. Know the location of the safety showers and eye washes and how to operate them. Know the escape routes from the lab and where you would call 911 after leaving the lab area.

Honor Code
All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the academic integrity policy of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at honorcode.colorado.edu.

Accommodation for Disabilities
If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Injuries guidelines under the Quick Links at the Disability Services website and discuss your needs with your professor.

Religious Observances
Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please contact me by email to discuss your particular conflict and an appropriate accommodation.

See the campus policy regarding religious observances for full details.
Classroom Behavior
Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the student code.

Sexual Misconduct, Discrimination, Harassment, and/or Related Retaliation
The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU’s Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder’s Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website.